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These conclusions regarding the status of coho salmon north of San Francisco are based on information in the preceding chapters of this report as well as the specific sources cited in this chapter. Sources include the best available scientific data on abundance and trends, distribution and metapopulation structure, and any identifiable threats to persistence. In some cases there are significant data gaps that make it difficult to arrive at precise estimates of the rate and magnitude of losses. Despite this uncertainty in some of the data, patterns and trends in many of the available indices documenting overall declines in California coho salmon populations are self-evident. These conclusions form the basis for the Department's recommendations in the following chapter of this report.

The Department did not find any evidence to contradict the conclusions of previous status reviews that coho salmon populations have suffered declines in California. Conversely, new evidence was found that supports these conclusions. The Department concludes that California coho salmon have experienced a significant decline in the past 40 to 50 years. California coho salmon populations have been individually and cumulatively depleted or extirpated and the natural linkages between them have been fragmented or severed. Coho salmon abundance in California, including hatchery stocks, could be six to 15 percent of their abundance during the 1940s, and has experienced a decline of at least 70% since the 1960s.

Changes in coho salmon distribution and abundance must be evaluated against a background of natural variation due to cyclic and changing environmental factors. Ocean conditions are known to have changed in recent years. These cyclic and non-cyclic changes have undoubtedly affected perceived and measured coho salmon distribution and abundance. However, viewed over the long-term, coho salmon populations are presently more vulnerable to adverse effects of this natural variation due to small population sizes, range restrictions, and fragmentation that has occurred since the 1940s. Natural variation is not likely to cause local extinctions unless populations are already severely depressed due to other causes.

Hatchery production has declined dramatically in recent years largely due to lack of spawners. Recent five-year averages for Warm Springs, Mad River, and Iron Gate hatcheries, and Noyo Egg Taking Station are only 11% to 44% of the average production between 1987-91. While some of this reduction can be attributed to reduced production targets, lack of spawners has been the most important natural limit to production. Only Trinity River Hatchery has maintained production at historical levels, and only Trinity River Hatchery and Iron Gate Hatchery currently produce relatively large numbers of coho salmon.

Coho salmon harvest dropped-off considerably in the late 1970s, despite a fairly stable rate of hatchery production. By 1992, ocean stocks were perceived to be so low that the commercial fishery was closed to protect them. Similarly, coho salmon retention in the ocean sport fishery ended with the 1993 season. Analysis of presence-by-brood-year, field surveys conducted from 1995 through 2001, recent abundance trend information for several streams systems along the central and north coasts, and ocean harvest data all predominantly indicate an overall declining trend throughout the state.

Southern Oregon/Northern California Coast Coho ESU

The analysis of presence-by-brood-year data indicates that coho salmon occupy only about 61% of the SONCC Coho ESU streams that were identified as historical coho salmon streams by Brown and Moyle (1991) so it does appear that there has been a fairly substantial decline in distribution within this ESU. However, our data do not support a significant decline in distribution since the late 1980s, as evidenced by the comparison of brood year presence in streams common to both the 1986 through 1991 and 1996 through 2000 periods. This analysis and the 2001 presence surveys indicate that some streams in this ESU have may have lost one or more brood-year lineages.

The 2001 presence survey data may also indicate a decline in distribution in the SONCC Coho ESU. These data show a substantial reduction in the number of historical streams occupied by coho salmon, especially for the Mattole, Eel, and Smith river systems, where coho salmon appeared to be absent from 71%, 73%, and 62% of the streams surveyed, respectively. These data should be interpreted with caution, however, because they represent only one year of surveys, and 2001 was a drought year on the north coast. Nevertheless, the inability to detect coho salmon in streams that were historically documented to have contained them and are considered by biologists to contain suitable coho salmon habitat is significant, especially to the high degree that coho salmon were not found in these surveys (59% of all streams surveyed).

Adult coho salmon counts at Benbow Dam on the South Fork Eel River showed a substantial decline in this system from the mid-1940s to the 1970s. Other trend indicators show declining or stable trends, with the only exception being coho salmon counts at Sweasey Dam on the Mad River, which shows a relatively large increase in the coho salmon population in 1962 and 1963. However, returns of adult coho salmon at Mad River Hatchery indicate a declining trend in this river in more recent years.

Considered separately, none of these lines of evidence provide conclusive evidence that coho salmon have experienced a substantial decline throughout the SONCC Coho ESU, because they are either limited in scope or are not particularly robust in detecting trends within specific watersheds. However, most of these indicators show declining trends, and in that respect, provide a high likelihood that populations have declined significantly and are continuing to decline. Some of the indicators show an upward trend in 2000 and 2001 that may ameliorate this downward trend slightly, but the overall trend is still downward in most cases, and most indicators of abundance show values that are much reduced from historical levels.

Although stocks in the SONCC Coho ESU appear to be declining and distribution within the watersheds appears to be reduced, population structure within the larger systems does not show population fragmentation as severe as that of the CCC Coho ESU. All major stream systems within this ESU still contain coho salmon populations, hence they are likely not as vulnerable to extirpation from adverse climatic or oceanic conditions or demographic effects of fragmented populations. Also, the presence-by-brood-year analysis indicates that the decline in distribution appears to have stabilized since the mid-1980s. For these reasons, the Department concludes that the SONCC Coho ESU is not presently threatened with extinction. However, because of the decline in distribution prior to the 1980s, the possibility of a severe reduction in distribution as indicated by the field surveys, and the downward trend of most abundance indicators, the Department believes that coho salmon populations in this ESU will likely become

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endangered in the foreseeable future in the absence of the special protection and management efforts required by CESA.

Central California Coast Coho ESU

The 2001 presence surveys in the northern portion (Mendocino County) of the CCC Coho ESU show a level of occupancy of historical streams that is similar to the SONCC Coho ESU. However, stream systems south of Mendocino County show a much greater proportion of streams in which coho salmon were not found. These surveys and other recent monitoring indicate that widespread extirpation or near-extinctions have already occurred within some larger stream systems (e.g. Gualala and Russian rivers) or over broad geographical areas (e.g. Sonoma County coast, San Francisco Bay tributaries, streams south of San Francisco). Only three streams in the Russian River system still contain coho salmon, and only one of these populations exists in appreciable numbers. Currently, there is an emergency captive breeding effort underway to keep Russian River coho salmon from becoming extinct. In the Sonoma County coastal area, coho salmon appear to be extirpated or barely persisting. Coho salmon were last observed in the Gualala River system in just two tributaries in 1995, and surveys of these streams in 1999, 2000, and 2001 failed to find coho salmon. The last year of observation of coho salmon in San Francisco Bay tributaries was in 1981. Coho salmon are now present in appreciable numbers in only three, possibly four streams south of San Francisco.

Most abundance trend indicators for streams in the CCC Coho ESU indicate a decline since the late 1980s. However, some streams of the Mendocino County coast showed an upward trend in 2000 and 2001. Time series analysis for these streams show a declining trend and predict that this trend will continue, despite the recent increases.

There is anecdotal evidence that relatively large numbers of coho salmon adults returned to some Marin County streams (e.g. Lagunitas Creek) in 2001. Lagunitas Creek and nearby tributaries still harbor coho salmon populations, and Lagunitas Creek appears to have a relatively stable, albeit small, population since the mid-1990s. However, small population sizes and the resulting isolation of this region, because of extirpation of coho salmon populations to the north and south, increases the vulnerability of these populations to extinction due to catastrophes, extreme variation in climatic and oceanic conditions, or adverse demographic effects.

Streams in the northern portion of this ESU seem to be relatively stable or are not declining as rapidly as those to the south. However, the southern portion, where widespread extinctions and near-extirpations have occurred, is a major and significant portion of the range of coho salmon in this ESU. Extant populations in this region appear to be small. Small population size along with large-scale fragmentation and collapse of range observed in data for this area indicate that metapopulation structure may be severely compromised and remaining populations may face greatly increased threats of extinction because of it. For this reason, the Department concludes that coho salmon in the CCC Coho ESU are in serious danger of extinction throughout all or a significant portion of their range.

Factors Affecting the Decline

The pattern of decline and localized extirpation of coho salmon in California mirrors that of steelhead, and to a lesser extent chinook salmon (both of which are also federally-listed species), in that the severity of the decline and number of extirpated populations increases as one

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moves closer to the historical southern limit of their range. Thus, the process of localized extinction seems to be moving northward and is an indication that freshwater habitat in these marginal environments is less able to support coho salmon populations than in the past.

Freshwater habitat loss and degradation has been identified as a leading factor in the decline of anadromous salmonids in California and coho salmon do not appear to be an exception to this. Timber harvest activities, especially past and present road construction, have had deleterious effects on coho salmon habitat. Diversion of water for agricultural and municipal purposes and dams that block access to former habitat have resulted in further diminishment of habitat. Water quality in historical coho salmon-bearing streams has declined substantially, as evidenced by the number of north and central coast streams that have been placed on the list of impaired water bodies pursuant to Section 303 of the CWA.

Other factors such as commercial and recreational fishing, illegal harvest, predation, changes in ocean conditions and productivity, and hatchery operations do not appear to be as significant in the decline of California coho salmon stocks. Ocean commercial and recreational harvest of coho salmon in California has been prohibited since 1993 and 1994, respectively, and inland sport harvest has been prohibited since 1998. Illegal harvest does occur, but is mostly the result of misidentification, or is opportunistic and not widespread.

Numerous studies have shown that salmonids are a minor component in the diet of marine mammals. However, when a prey population has been reduced, a very small amount of predation pressure can have a significant impact on the population, although there is no evidence that this is occurring with coho salmon in California. Predation can be significant where physical conditions lead to a concentration of adults or juveniles, or when altered ecological conditions favor an introduced predator.

Some ocean condition factors favorable to salmonids are cyclic. It appears that current productivity in the ocean is relatively high, as evidenced by large returns of chinook salmon to west coast streams in recent years, and by recent upswings in coho salmon abundance indicators in some places. Productive ocean conditions, by enhancing survival, can mask reduced productivity associated with freshwater habitat loss. When unfavorable ocean conditions occur in combination with degraded freshwater habitat conditions, productivity is greatly reduced and populations that are already fragmented and small become more vulnerable to extinction.

Hatcheries have historically been active throughout the range of coho salmon in California and have produced numbers of fish that, while relatively small in a coastwide sense, are significantly large relative to natural production in places where large hatcheries have been active. Although hatcheries may have produced some benefits to local coho salmon populations (some stocks in the CCC Coho ESU may exist only because of relatively constant input of hatchery-origin coho salmon), hatcheries have also had the opportunity to adversely affect natural California coho salmon populations. However, it is unclear exactly whether or how hatchery fish and/or hatchery operations have affected and are affecting California's natural coho salmon populations. Hatcheries in California have dramatically reduced their production of coho salmon, limited outplanting, and stopped virtually all stock transfers in recent years. Therefore, current impacts of hatchery fish and operations on remaining natural stocks may be significantly less than in the past. Their potential to cause adverse impacts to natural stocks is severely limited by decreased production and modern management policy.

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